Recent Geodetic Results in the Azores Triple Junction Region

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Abstract—GPS (Global Positioning System) observations started to be carried out in the Azores region under the scope of the TANGO (TransAtlantic Network for Geodesy and Oceanography) project in 1988. The measurements carried out between 1993 and 2000 (five campaigns) on nine GPS sites (one per island) were reprocessed using two state-of-the-art software packages. Different methodologies were applied to compute each campaign solution and the derived velocity field. The velocity fields, including the motions of two permanent stations, recently installed in the Azores, were computed within the most recent geodetic reference frame, ITRF2000 (International Terrestrial Reference Frame, solution 2000). They are compared with the motions of the stable rigid tectonic plates using as reference DEOS2k, a global tectonic model developed using geodetic data. The relative motions between the Western and Central groups of islands yield to evaluate the opening rate of the Mid-Atlantic Ridge (boundary between the North American plate and the Eurasian and African plates). Concerning the boundary between the Eurasian and African plates, the motion of the TANGO sites in the Central and Eastern groups clearly identifies the transition pattern between those two plates. Two of the sites are considered to be located in the stable part of these plates, whereas the remaining five are within the deformation region of the Eurasia-Africa boundary. The conclusions are analyzed in view of the different deformation models, derived from geodynamic or geophysical data that have been proposed for the region.

Key words: Azores Triple Junction, GPS processing, plate tectonics.

1. Introduction

The Azores Archipelago is located in the junction area of three major tectonic plates: Eurasia, Africa and North America. The complex tectonic processes caused by the interaction between these plates put permanently at risk the life and assets of the thousands of inhabitants of the Azores Archipelago. The most recent example is the 9 July 1998 earthquake that struck the island of Faial causing nine casualties.

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Figure 1 shows the major tectonic settings of the Azores Triple Junction region. The boundary between North America and the other two plates is well defined by the Mid-Atlantic Ridge (MAR). As for the western segment of the Eurasia-Africa plate boundary, the exact location and the features in the region of the Azores Plateau (submarine platform roughly limited by the 2000 m bathymetric contour (LOURENÇO et al., 1998)) are not yet well determined. During the last two decades, several models have been proposed based upon various geological and geophysical analyses: the Terceira Rift model (BUFORN et al., 1988); the Azores Microplate model (FREIRE LUIS et al., 1994); the Leaky Transform model (MADEIRA and RIBEIRO, 1990). Recently, different works, based on bathymetric (LOURENÇO et al., 1998), gravimetric (LUIS et al., 1998), and seismic (MIRANDA et al., 1998) data have proposed a new model for the Azores Plateau region, called the Azores Blocks model. These authors state that, presently, the Azores domain is a narrow diffuse plate boundary consisting of several tectonic blocks limited by two sets of faults, oriented in the directions N120E and N150E. This area acts simultaneously as an oblique ultra slow spreading center and as a transfer zone that accommodates the differential shear movement between the Eurasian and African plates from the MAR until the beginning of the Gloria fault (a fairly straight dextral transform fault well mapped by bathymetry (ARGUS et al., 1989)).